

**PALEOCENE STRATIGRAPHY OF THE NESSON ANTICLINE:
PLACEMENT OF THE BULLION CREEK-SENTINEL BUTTE FORMATIONAL CONTACT,
WILLIAMS AND MCKENZIE COUNTIES, NORTH DAKOTA**

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Since the Fort Union Group was designated by Meek and Hayden (1), which strata should be included within the group, how it can be subdivided, and what the appropriate nomenclature for these designations should be have remained controversial (2-5). The lithostratigraphy of the outcrops of the Fort Union Group along the bluffs of the Missouri River are of particular concern from a paleontological perspective, because they contain the type localities of a relatively large number of nonmarine mollusks described by Meek and Hayden (6, 7). The placement of the 195 known molluscan localities within a well-founded stratigraphic context is critical to a meaningful biostratigraphy and temporal interpretation of the late Paleocene in North Dakota (8). This communication presents recent stratigraphic and paleontologic research bearing on the placement of this contact relative to named coal beds exposed about the Nesson Anticline in T. 153-154 N., R. 95 W., of southeastern Williams and northeastern McKenzie Counties. This work is part of ongoing stratigraphic and paleontologic studies concerning the greater Fort Union Historic Site area (9).

The placement of the contact between the Bullion Creek (or Tongue River of some workers) and Sentinel Butte Formations in the upper part of the Fort Union Group has been problematic in North Dakota outside of its best delimited area in portions of Billings, Golden Valley, and southern McKenzie Counties. Relevant Paleocene stratigraphic studies in the area of the Nesson Anticline include the naming of the feature and correlation of coal beds by Collier (10), coal studies and/or the placement of the contact (without descriptive explanation) by Nevin (11), Freers (12), Spencer (13), and Clayton (14), and descriptive consideration to the placement of the contact by Royse (3) and Carlson (5). Royse (3) documented the criteria needed to recognize the Bullion Creek-Sentinel Butte contact throughout the Little Missouri River drainage in western North Dakota. The results of his observations on the Missouri River formed, in part, the basis for Clayton's (14) interpretation of the contact as portrayed on the North Dakota State Geologic Map. The contact along the Missouri River was only generally defined by maps of small scale by the works of Royse and Clayton, but the levels appear to be defined at about the horizon of the Williston coal bed (Royse) or higher (Clayton) as recognized in this area. Royse (3) also noted that, on the basis of his criteria, the contact chosen by Nevin (11, horizon L) was "at least 200 ft [61 m]" too high in the section about the Keene Dome, an observation with which the authors concur. The placement of the contact by Freers (12) is consistent with that of the Williston coal and associated clinker on the north side of the Missouri River. Spencer (13) differed from other studies by placing the contact at the top of the Pittsley coal bed, about 61 m (200 ft) below the Williston bed.

Recent stratigraphic studies by the authors (unpublished observations of 1987, 1990-1992) in the area of the Nesson Anticline suggest that the contact may be most consistently placed at about the horizon of an unnamed lignite 11 to 13 m (35 to 44 ft) below the Pittsley coal bed. The unnamed bed is part of a sequence of three coals that may represent the uppermost part of the Bullion Creek Formation in this general area. This decision is based on the interpretation of geologic sections measured through this portion of the Fort Union Group on both the north and south sides of the Missouri River, observations in the Fort Union area, and subsurface correlations. The occurrence of Sentinel Butte-like lithologies and colors interpreted by others (e.g., Carlson) to be within the Bullion Creek, are, by our definition, believed to be part of the Sentinel Butte Formation. The proposed placement of the contact, along with the collection of mollusks from a number of localities in this area, suggest that a few important Meek and Hayden molluscan type localities, previously of dubious stratigraphic position, may occur in the Sentinel Butte Formation rather than the Bullion Creek Formation as generally thought (6). The stratigraphic range of other taxa may be modified by these studies and enhance the resolution of nonmarine molluscan biostratigraphy in the greater type area of the Fort Union Group. This research has been supported by the National Science Foundation, the U.S. Department of Energy, and the U.S. Bureau of Mines.

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A DIVERSE ASSEMBLAGE OF PALEOCENE NONMARINE MOLLUSKS AND MAMMALS FROM THE SENTINEL BUTTE FORMATION OF NORTH DAKOTA

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Diverse nonmarine mollusk assemblages are uncommon in strata of Paleocene age. A local fauna with more than eight taxa (the average is about four) is usually due to the admixture of freshwater and terrestrial taxa. This communication is the first report of an unusually diverse assemblage of at least 26 taxa of both freshwater and terrestrial mollusks from a Paleocene locality in North Dakota. This assemblage, known as the Riverdale Locality, is in the Sentinel Butte Formation and is middle late Paleocene age. Land mammal age abbreviations used herein are La = Lancian (latest Cretaceous), To and Ti = Torrejonian and Tiffanian (middle and late Paleocene), and Wa = Wasatchian (Early Eocene).

The Riverdale Locality (L1) was discovered on the shores of Lake Sakakawea near Riverdale, McLean County, in the early 1960s by the Vinje family of Hazen (1). Although known primarily for its mammalian fossils (2), a few interesting terrestrial mollusks were part of the original collections (3). The Riverdale Locality of the Vinjes was destroyed by the then rising waters of the reservoir, but lowering lake levels of the late '80s exhumed a comparable lithology in the same (quite specific) location. From available data (2, 4), the Riverdale sites discovered over the last few years (e.g., L5507 and L6200) are stratigraphically, at the most, from 5.8 to 7.9 m above the Vinje's Riverdale Locality, respectively.

The Riverdale molluscan assemblage consists notably of a diverse assemblage of snails (see table; * = land snails). Many, if not most, of the taxa, are undescribed. The named taxa, *Viviparus leai*, *V. retusus*, *Grangerella mcleodensis* (see 5), and New Genus T *planoconvexa* indicate a late Paleocene age. In addition, the terrestrial assemblage is remarkable in that it shares no taxa in common with the Ti3-age Judson local fauna (L6-L8, L25) from near the Slope-Bullion Creek formational contact in Morton County. The record of *G. mcleodensis*, known previously from Paleocene formations of Alberta, is its first report in the United States. The record of New Genus T *planoconvexa* is its first report in North Dakota since it was first described in 1857 from the Sentinel Butte Formation near Fort Berthold on the Missouri River (L4279) (6). The mollusks indicate a moist tropical or subtropical forest near a shallow lacustrine environment associated with a major fluvial system.

The Riverdale Locality (L1) was previously reported as belonging to mammalian biochron Ti4? (early late Tiffanian) (1). A reassessment of the mammalian local fauna identifies the following taxa: Order (O.) Multituberculata — *Ptilodus kummae* (Ti3-Ti4), O. Proteutheria — *Propalaeosinopa* sp. (To3-Ti5), O. Condylarthra — *Phenacodus magnus* (Ti4-Ti5), an indeterminate arctocyonid (La-Wa), and O. Pantodonta — *Titanoides primaevus* (?Ti3-Ti5?). Although a Ti4 biochron is indicated by this fauna, the identification of *P. magnus* at certain localities does not rule out the possibility of a Ti3 age for the Riverdale Locality. Note that this small local fauna does not share any species in common with the Ti3-age Judson and Brisbane (L5385, Slope Formation in Grant County) Localities. This research has been supported by the National Science Foundation, the U.S. Department of Energy, and the U.S. Bureau of Mines.

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RIVERDALE MOLLUSKS

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|---|
| Class Bivalvia |
| Subclass Heteroconchia |
| Order Unionoida |
| Family Unionidae |
| Gen. & sp. undet. |
| Order Veneroida |
| Family Pisidiidae |
| Gen. & sp. undet. |
| Class Gastropoda |
| Subclass Prosobranchia |
| Order Diotocardia |
| Family Grangerellidae |
| <i>Grangerella mcleodensis</i> * |
| Order Mesogastropoda |
| Family Viviparidae |
| <i>Viviparus leai</i> |
| <i>Viviparus retusus</i> |
| Family Hydrobiidae |
| <i>Hydrobia</i> spp. |
| Family Pleuroceridae |
| <i>Lioplacodes nebrascensis</i> |
| <i>Lioplacodes</i> sp. B |
| Order & Family <i>incertae sedis</i> |
| New Gen. A <i>limneaformis</i> |
| Subclass Pulmonata |
| Order Archaeopulmonata |
| Family Ellobiidae |
| <i>Pleurolimnaea tenuicosta</i> |
| Order Basommatophora |
| Family Acroloxidae |
| Gen. & sp. undet. |
| Family Physidae |
| <i>Physa</i> cf. <i>P. canadensis</i> |
| Family Planorbidae |
| Gen. & sp. undet. |
| Order Stylommatophora |
| Family undet. |
| New Gen. T <i>planoconvexa</i> * |
| Family Discidae |
| <i>Discus</i> cf. <i>D. sandersoni</i> * |
| <i>Discus</i> cf. <i>D. marmorensis</i> * |
| Family Oreohelicidae |
| <i>Radiocentrum</i> sp. A* |
| Gen. undet. sp. A* |
| Gen. undet. sp. B* |
| Family Zonitidae |
| cf. <i>Mesomphix</i> sp. A* |
| cf. <i>Vitrea</i> sp. B* |
| Stylommatophora <i>incertae sedis</i> |
| "Big tree snail" (? <i>Glypterpes</i>)* |
| "Carinate helicoid" |
| "Conic helicoid" |
| "Bulbous helicoid" |
| "The Ribmeister" |